

## CLAIMS

1. A variable valve operating device for mechanically changing the operating characteristic of a valve relative to rotation of a camshaft, comprising:
  - 5 a drive cam disposed on the camshaft;
  - a control shaft disposed to extend in parallel with the camshaft, the control shaft being capable of changing the rotation position continuously or
  - 10 stepwise;
  - a swing member swinging about an axis extending in parallel with the camshaft;
  - a swing cam surface formed on the swing member, the swing cam surface making in contact with a valve support member for supporting the valve to press the valve in a lifting direction;
  - 15 a slide surface formed on the swing member so as to oppose the drive cam;
  - an intermediate member disposed between the drive cam and the swing member, the intermediate member making in contact with both a cam surface of the drive cam and the slide surface; and
  - 20 an interlock mechanism for changing a position of the intermediate member on the slide surface by interlocking with the rotation of the control shaft;
  - 25 wherein the slide surface is formed to be curved

toward the drive cam so that the distance from the center of the camshaft increases from the nearest point from the swing center of the swing member toward the farthest point from the swing center of the swing  
5 member within the area which the intermediate member contacts; and

wherein the swing cam surface includes a nonoperating surface having a constant distance from the swing center of the swing member and giving the  
10 valve no lift and an operating surface disposed to continue into the nonoperating surface so that the distance from the swing center of the swing member becomes gradually greater, and a contact position of the valve support member on the swing cam surface  
15 shifts from the nonoperating surface to a side of the operating surface as the swing member swings.

2. The variable valve operating device according to claim 1, wherein the slide surface is formed so that  
20 the distance from the center of the camshaft increases with an increase in the distance from the swing center of the swing member.

3. The variable valve operating device according to claim 1 or 2, wherein a position of the drive cam in  
25 contact with the intermediate member in a

circumferential direction at the same rotation position of the camshaft moves to an advance side of the camshaft as the position of the intermediate member on the slide surface is further away from the swing center 5 of the swing member.

4. The variable valve operating device according to any one of claims 1 to 3, wherein the intermediate member includes a first roller that makes in contact 10 with the cam surface of the drive cam and a second roller that is rotatable relative to the first roller and makes in contact with the slide surface.

5. The variable valve operating device according 15 to any one of claims 1 to 4, wherein the swing member is rotatably mounted on the control shaft and rocks about the control shaft.

6. The variable valve operating device according 20 to claim 5, wherein the interlock mechanism includes a control member fixed to the control shaft and having a pivot at a position eccentric from the center of the control shaft and a connecting member mounted rockably on the pivot and connecting the intermediate member to 25 the control member.

7. The variable valve operating device according to claim 6, wherein the control member is formed as a disc having a center at a position eccentric from the control shaft and the connecting member is mounted 5 rotatably on an outer peripheral surface of the disc.

8. The variable valve operating device according to claim 5, wherein the interlock mechanism includes a control member mounted rotatably on the camshaft, a 10 support member mounted on the control member, the support member for supporting the intermediate member movably along a predetermined path, and a rotation interlock mechanism for interlocking the rotation of the control member about the camshaft with the rotation 15 of the control shaft.

9. The variable valve operating device according to claim 8, wherein the support member is formed as a guide integrated with the control member.

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10. The variable valve operating device according to claim 8, wherein the support member is formed as a link member mounted on the control member rockably about a position eccentric from the camshaft, 25 the link member providing a link coupling between the control member and the intermediate member.

11. The variable valve operating device according to any one of claims 1 to 10, further comprising:

- 5           a second drive cam disposed on the camshaft in juxtaposition with the drive cam;
- a second swing member disposed coaxially with the swing member, the second swing member being able to swing independently of the swing member;
- 10          a second swing cam surface formed on the second swing member, the second swing cam surface making in contact with a valve support member for supporting a second valve disposed in juxtaposition with the valve to press the second valve in a lifting direction;
- 15          a third swing member disposed coaxially with the swing member, the third swing member being able to swing independently of the swing member and the second swing member and making in contact with a cam surface of the second drive cam; and
- 20          interlock selecting means for selectively interlocking the second swing member with either the swing member or the third swing member.